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EXAMINER

TRINH, MICHAEL MANH

ART UNIT PAPER NUMBER

2822

DATE MAILED: 12/13/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/804,397

Applicant(s)

CHANG ET AL.

Examiner

Michael Trinh

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 28 September 2006.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-20 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-20 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

*** This office action is in response to Applicant's Amendment filed September 28, 2006, 2006. Claims 1-20 are pending.

*** The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

Claim Rejections - 35 USC § 103

1. Claims 1,4-12,15-20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Jung et al (6,335,279) taken with Fulford (5,847,428) and Peng (6,004,851).

Re claim 1, Jung teaches (at Figs 3C-3M; col 6, line 15 through col 9) a method for forming a semiconductor device comprising at least the steps of: providing a substrate having a gate electrode 116 formed thereon (Figs 3D; col 6, lines 41-49); performing a first ion implant to form region 122a-122b wherein the gate electrode 116 acts as a mask (Fig 3E, col 6, lines 50-60); forming a first spacer 124 on the substrate adjacent to the gate electrode (Fig 3F, col 6, line 61 through col 7); forming an etch stop layer 126 on the substrate such that the etch stop layer 126 covers the first spacer 124 and the substrate (Fig 3G; col 7, lines 13-25); forming a sacrificial spacer 132 on the etch stop layer 126 on the substrate adjacent to the first spacer 124 (Fig 3I; col 7, lines 13-48); performing a second ion implant wherein the sacrificial spacer and the first spacer act as a mask; and removing the sacrificial spacer 132 (Fig 3J, col 8, lines 1-8).

Re claim 12, Jung teaches (at Figs 3C-3M; col 6, line 15 through col 9) a method for forming a semiconductor device comprising at least the steps of: providing a substrate having a gate electrode 116 and a shallow trench isolation (STI) 104 formed thereon (Figs 3D; col 6, lines 41-49; lines 8-15); forming a lightly doped drain 122a-122b in the substrate adjacent to the gate electrode 116 (Fig 3E, col 6, lines 50-60); forming a first spacer 124 on the substrate adjacent to the gate electrode (Fig 3F, col 6, line 61 through col 7); forming an etch stop layer 126 over the substrate 100, the first spacer 124, and over the STI 104 (Fig 3G; col 7, lines 13-25); forming a sacrificial spacer 132 on the etch stop layer 126 adjacent to the first spacer 124, the etch stop layer 126 preventing damage to the STI (Fig 3I, col 7, lines 13-48,44-48); performing a second ion implant wherein the sacrificial spacer and the first spacer acts as a mask; and removing the sacrificial spacer 132 (Fig 3J, col 8, lines 1-8). Re claim 4, wherein the etch stop layer 126

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covers a shallow trench isolation 104 (Fig 3G; col 7, lines 13-25; and Fig 3D; col 6, lines 41-49; lines 8-15). Re claim 6, wherein the first spacer comprises a silicon nitride (col 6, line 64 through col 7, line 25). Re claims 7,19, wherein the etch stop layer 126 is an oxide (col 7, lines 13-19). Re claims 8-9,16,18, wherein the sacrificial spacer 132/128 comprises a silicon nitride (Si_3N_4) (col 7, lines 19-55), and performing an anisotropic dry etch back (col 9, lines 15-20; col 7, lines 25-36; col 1, lines 45-54). Re claims 10,20, wherein the etch stop layer 126 is an oxide formed by chemical vapor deposition techniques (col 7, lines 15-19). Re claims 11,17, wherein removing the sacrificial layer 132 is performed by an etch process using a solution of phosphoric acid (col 8, lines 1-8).

Re claims 1 and 12, Jung already teaches removing the sacrificial spacer 132 to retain the etch stop layer and the first spacer having substantially the same shape as achieved in the step of forming a first spacer.

Jung just lacks performing a third ion implant through the etch stop layer with the first spacer acting as a mask (claims 1 and 12). Re claims 5,15, performing a third ion implant before forming a second ion implant.

However, Fulford teaches (at Figs 13-15) after removing the sacrificial spacer 160, forming a doped region by performing a third ion implant 182 with the first spacer 136 as a mask, the third ion implant being performed through the etch stop layer 146 (as the CVD deposited etch stop layer 146 is an entire layer over the substrate, Fig 9; col 8, lines 42-66; and Figs 15,14; col 9, line 66 through col 10, line 67; Figs 9-14), after forming second ion implantation 170, wherein the first spacer is having substantially the same shape as achieved in the step of forming a first spacer. Re claim 5, Fulford also alternatively teaches (at Figs 8-12) performing a third ion implant 140 to form a doped region (Fig 8; col 8, lines 30-67) before forming a second ion implant 164 (Fig 12; col 9 lines 1-30). Peng also teaches (from Fig 2e to 2h) after removing the sacrificial spacer 22a (Fig 2e, col 4, lines 25-35), performing a third ion implant to form a doped region 25 with the first spacer 21b as a mask (Fig 2h; col 4, lines 39-49).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to form the semiconductor device of Jung, after removing the sacrificial spacer, by performing a third ion implant wherein the first spacer acts as a mask, as taught by

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Fulford and Peng, wherein the third ion implant is performed through the etch stop layer, as disclosed by Fulford. This is because of the desirability to form an enhanced lightly doped region so as to reduce reverse junction leakage current and further suppress hot carrier effects, wherein the lightly doped region can be formed in the substrate by implanting ions into the substrate, either before or after the second ion implanting as an alternative way.

2. Claims 2-3,13-14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Jung et al (6,335,279), Peng (6,004,851) and Fulford (5,847,428), as applied to claims 1,4-12,15-20 above, taken with Bu et al (6,812,073).

The references including Jung teach (at Figs 3C-3M; col 6, line 15 through col 9) a method for forming a semiconductor device, as applied to claims 1,4-12,15-20 above.

Jung already teaches etching to form the first spacer 124 (Figs 3F-3M), but lacks forming a dielectric liner acts as an etch stop (claims 2,13), wherein exposed portions of the dielectric liner are removed after forming the first spacer (claims 3,14).

However, Bu teaches (at Figs 1B-1C) forming the first spacer 30 and forming a dielectric liner 28 (Fig 1B) on the substrate, and etching a spacer layer to form the first spacer 30 wherein the dielectric liner 30 acts as an etch stop (col 4, lines 17-27; col 3, line 58 through col 4, lines 54).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to form the semiconductor device of Jung by further forming a dielectric liner on the substrate and acting an etch stop during etching to form the first spacer, as taught by Bu. This is because of the desirability to protect the underlying layers, and to prevent significant effect and damage to other layers during etching to form the first spacer.

Response to Amendment

3. Applicant's remarked filed September 28, 2006 with respect to pending claims 1-20 have been considered but they are not persuasive.

** Applicant remarked (at 9/28/06 remark, page 6, last paragraph) that

“...Jung explicitly teaches away from the combination asserted by the Office action. In particular, Jung explicitly teaches that a third ion implant is *not performed* after removing the sacrificial spacer...” (underlying added).

In response, this is noted and found totally unconvincing. Applicant alleged that “Jung explicitly teaches away...” and “Jung explicitly teaches that a third ion implant is *not performed* after removing the sacrificial spacer”. However, *nowhere in the disclosure of the Jung prior art reference that explicitly teaches or mentions not to perform such third ion implant after removing the sacrificial spacer*. Indeed, Applicant fails to show and point out at which column and lines of Jung (6,335,279) that explicitly teaches not to perform a third ion implant after removing the sacrificial spacer.

** Applicant further alleged that “...Jung assertedly discloses that a second ion implant is performed and then the sacrificial spacers 132 are removed *without performing a third ion implant...*”. However, it is the fact that nowhere in the disclosure of the Jung prior art reference that mentions without performing a third ion implant. Indeed, Applicant fails to show and point out at what column and lines of Jung (6,335,279) that assertedly and explicitly discloses the phrase “...*without performing a third ion implant...*”.

** Applicant further remarked at (remark page 76, second paragraph) that

“In fact, Jung adds significant process steps to ensure that the impurity regions 134a and 134b are positioned away from the first spacers 124....*If positioning the impurity regions 134a and 134b away from the first spacers was not necessary to Jung, then presumably Jung would have simply performed the second ion implant using only the first spacers 124 as a mask... and would have never spent the valuable time and resources forming and then removing the sacrificial spacers*”

In response, Applicant apparently misunderstood the motivation and suggestion to combine the references as mentioned in the Office action, since the Office action is **still** relied on the Jung reference for having the step of performing a second ion implant using the sacrificial spacer and the first spacer as a mask in order to ensure that the fully or heavily doped impurity

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regions 134a and 134b are positioned away from the first spacers 124. Moreover, nowhere in the Office action suggest to perform a second ion implant using only the first spacers as a mask. Nowhere in the Office action suggest positioning the impurity regions 134a and 134b away from the first spacers was not necessary to Jung...". Valuable time and resources in forming and then removing the sacrificial spacers are properly spent by Jung in order to ensure that the fully or heavily doped impurity regions 134a and 134b are positioned away from the first spacers 124.

Contrary to Applicant's remarks, Jung (6,335,279) is relied for teaching and showing a method comprising the claimed step of performing a second ion implant to form the impurity regions 134a/134b using the sacrificial spacer 132 **and** the first spacer 124 as a mask; and the step of removing the sacrificial spacer 132 (Figs 3I-3J). In the combination of the references, Fulford (5,854,428) and Peng (6,004,851) prima facie obviously teach, performing a third ion implant in order to form an enhanced lightly doped region so that this enhanced lightly doped region is further added and thereby formed between the fully/heavily doped impurity regions 134a/134b and the lightly doped region (LDD) 122a/122b of Jung (Figs 3I-3J), wherein the third ion implant to form the enhanced lightly doped region (an intermediate doped regions) can also be performed after removing the sacrificial spacer 132. Indeed, as explicitly and throughoutly mentioned by Fulford, a plurality of ion implanting steps with different concentrations are carried out in order to form lightly doped regions, enhanced lightly doped regions (e.g. intermediate doped regions), and fully/heavily doped regions so that a graded junction which minimize hot-carrier effects is desirably formed in the semiconductor substrate. The prior art motivation or advantage may be different than that of applicant while still supporting a conclusion of obviousness. In *Re Wiseman* 201 USPQ 658 (CCPA 1979); *Ex Parte Obiaya* 227 USPQ 58 (Bd. of App. 1985).

Therefore, it would have been prima facie obvious to one of ordinary skill in the art at the time the invention was made to form the semiconductor device of Jung, after removing the sacrificial spacer, by performing a third ion implant wherein the first spacer acts as a mask, as taught by Fulford and Peng, wherein the third ion implant is performed through the etch stop layer, as disclosed by Fulford. This is because of the desirability to form an enhanced lightly doped region so as to reduce reverse junction leakage current and further suppress hot carrier effects.

The Examiner recognizes that references cannot be arbitrarily combined and that there must be some logical reason why skilled in the art would be motivated to make the proposed combination of references. In *re Regel* 188 USPQ 136 (CCPA 1975). The test for combining

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references is what the combination of disclosures taken as a whole would suggest to one of ordinary skill in the art. In re McLaughlin 170 USPQ 209 (CCPA 1971); In re Rosselet 146 USPQ 183 (CCPA 196). References are evaluated by what they collectively suggest to one versed in the art, rather than by their specific disclosures. In re Simon, 174 USPQ 114 (CCPA 1972); In re Richman 165 USPQ 509, 514 (CCPA 1970).

Applicant's claimed invention fails to patentably distinguish over the state of the art represented by the cited reference. It is well settled that one can not show non-obviousness by attacking the references individually where, as here, the rejection is based on combinations of references. In re Young, 403 F.2d 754, 159 USPQ 725 (CCPA 1968); In re Keller 642 F.2d 413, 208 USPQ 871 (CCPA 1981). Moreover, the rejection is not overcome by pointing out that one reference does not contain a particular limitation when reliance for that teaching is on another reference. In re Lyons 150 USPQ 741 (CCPA 1966).

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Michael M. Trinh whose telephone number is (571) 272-1847. The examiner can normally be reached on M-F: 9:00 Am to 5:30 Pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Zandra Smith can be reached on (571) 272-2429. The central fax phone number is (703) 872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).
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Michael Trinh
Primary Examiner